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ELEVATION TEXTURE

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ABSTRACT

Given an array of terrain elevation values, texture analysis techniques can be used, in principle, for segmentation and terrain type classification.

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Texture analysis has been used in many pattern recognition applications, including radiology and cytology as well as remote sensing. For a general review of texture analysis concepts and techniques, see [1].

Conventionally, texture analysis is applied to images composed of gray levels, i.e., brightness or intensity values. In the field of remote sensing, intensity-based texture has been used for various types of terrain classification, based on geology, land use, etc. [1].

As a result of the growing interest in digital cartography, terrain elevation data is becoming increasingly available in digital form. The purpose of this note is to point out that arrays of elevation data can be used, either alone or in conjunction with (registered) intensity data, as a basis for texture analysis.

Figure 1 shows some samples of terrain elevation data, with elevation rescaled and displayed as gray level. Each sample is 128×128 pixels. The samples were extracted from an image in the DARPA/DMA Test Database.

It is evident that the samples in Figure 1 differ greatly in their textural properties. To confirm this, Table 1 shows a set of standard texture feature values [1] computed for these samples. Thus, such elevation-based texture feature values could clearly be used to classify terrain samples.

It should be pointed out that the vertical resolution of digital terrain elevation data is generally not high, so that in a small region of the terrain, the variations in elevation will not be great. Thus, to obtain distinctive textural patterns, it may be necessary to use relatively large terrain samples. Note that in Figure 1, the samples are 128×128, whereas in most of the past work using intensity-based texture features [1], samples of size 64×64 or smaller have generally been used.

Elevation data can also be used in combination with intensity data for terrain classification. LARS [2] has used elevation values as a "band", in conjunction with spectral intensity bands, for pixel classification. Haralick [1] has defined a "texture transform" which associates a texture-derived value with each pixel, and has used the array of these values as a "texture band". If desired, one could combine these two ideas to define an "elevation texture band". Another possibility is to apply multiband texture analysis [3] to a combination of intensity and elevation bands.

In summary, digital terrain elevation data can be used in a variety of ways as a basis for texture analysis. As such data become increasingly available, practical applications of this idea should begin to emerge.

References

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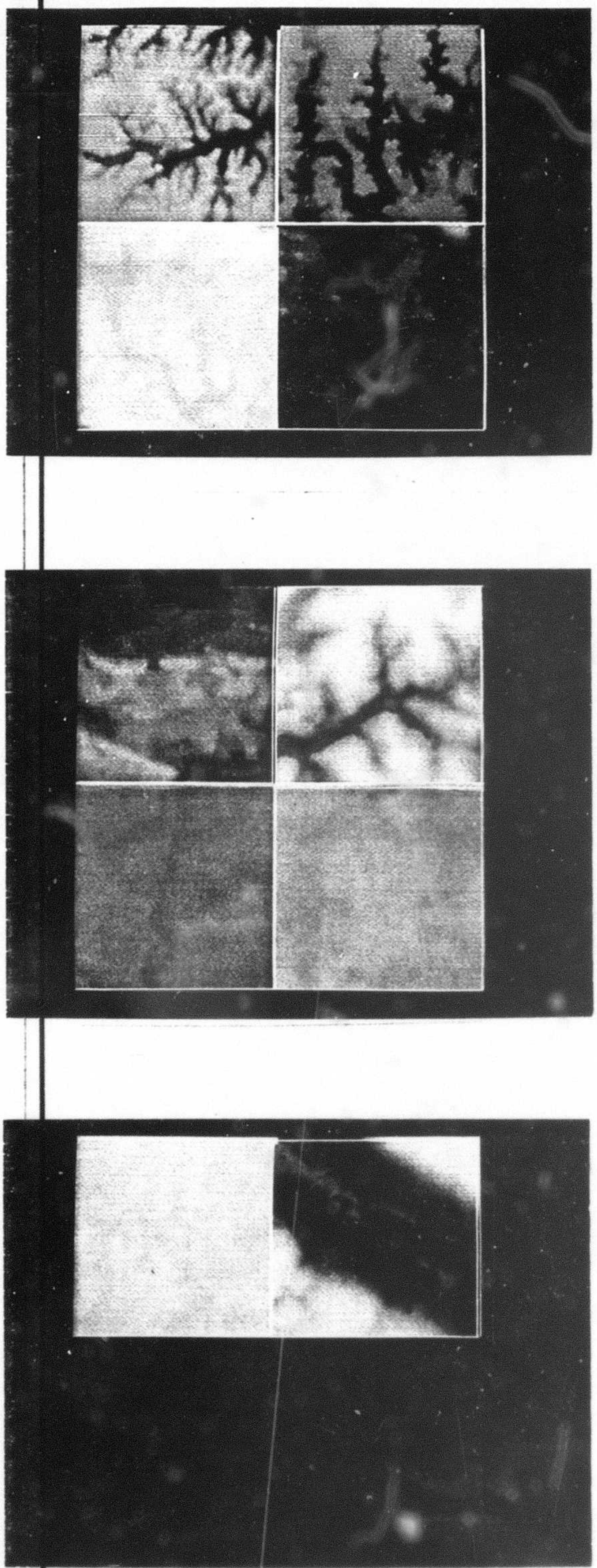

Figure 1. Samples of terrain elevation data.

Sample	CON	ASM	IDM
	Feature		
1	5.2	66	.045
2	3.6	45	.013
3	3.0	49	.033
4	1.9	20	.039
5	1.0	31	.027
6	7.6	107	.012
7	0.1	11	.010
8	0.6	18	.028
9	0.4	15	.036
10	12.4	91	.270

Table 1. Values of some standard texture features for the samples in Figure 1. The features are derived from the elevation co-occurrence matrix at displacement 1. Note the wide range of feature values.

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